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## EDUCATIONAL DIAGNOSIS

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## EDUCATIONAL DIAGNOSIS

**"Diagnosis" used with several meanings.** The words "diagnosis" and "diagnostic" have several different meanings in educational literature. "Diagnostic" has been used in the descriptive titles of certain tests to indicate their function. Test-makers, however, have not been uniform in this respect, as a number of tests called "diagnostic" appear to fulfill this function less completely than others not so labeled. Similar variations in the use of the word "diagnosis" occur in accounts of the interpretation and the use of test results.

The dictionary states that "diagnosis" means scientific determination of any kind. Thus, a teacher has diagnosed his pupils when he knows them scientifically. Another way of expressing the same idea is to say that educational diagnosis means accurate and detailed information concerning the educational status of pupils. A survey of recent literature relative to educational measurements and the remedial instructions which should follow the use of standardized tests reveals five fairly distinct concepts of educational diagnosis.

- I. General diagnosis.
- II. Complete diagnosis which is sometimes referred to as detailed diagnosis.
- III. Partial diagnosis which is the same as semi-diagnosis.
- IV. Analytical diagnosis.
- V. Differential or supplementary diagnosis.

**I. General diagnosis.** "General diagnosis" means just what the term "general" implies, namely, knowledge in a general way of the educational status of pupils. The information used in making a general diagnosis should be accurate, but does not go into detail. The general standing of the class relative to the norm or standard is shown and the pupils of high and of low achievement are "spotted." Thus any test which yields a simple general measure in the operations, or even in the entire field of arithmetic may be termed diagnostic in this sense. However, the use of the word "diagnosis" in a general sense is relatively rare; the meaning usually associated with the term is described under the head of "detailed diagnosis."

**Typical tests for general diagnosis.** The Courtis Standard Supervisory Tests in Arithmetic, Monroe's Standardized Reasoning

Tests, and the Woody-McCall Mixed Fundamentals may be mentioned as typical tests for general diagnosis in the field of arithmetic. Charters' Diagnostic Language and Grammar Tests fulfill a general diagnostic function when the number of exercises done correctly is taken as a pupil's score. All reading tests with the exception of the Haggerty Sigma 3 and all handwriting scales except the Gray Score Card may be considered as having a general diagnostic function.

It should be noted that none of these tests point out special weaknesses but merely call attention to the position of the class or of an individual pupil in regard to relative standing with norms. Norms are thought of as the degree of ability which a pupil or a group of pupils should possess. If the class makes a low score further study must be made to ascertain the real cause, and a number of factors may need to be taken into consideration.

**II. Complete or detailed diagnosis.** Complete diagnosis is based on the thesis that ability in such a field as arithmetic is made up of a number of separate or specific abilities. It is the opposite of general diagnosis; instead of a single measure representing achievement over the field of a school subject or a major division of it, there are several scores, each measuring a separate or specific ability. For example, the ability required for short-column addition is not the same as that for long-column addition. A still different ability is called for in an example requiring carrying. Detailed diagnosis refers to learning the degree of each of these specific abilities which a pupil has acquired, and involves the separate measurement of each. As the number of specific abilities appears to be very large, a complete diagnosis in any school subject would require more separate measurements than are practicable. For this reason we usually either group those abilities which are related, or confine our measurement to those which seem most significant.

**Typical tests for detailed diagnosis.** An excellent example of an instrument designed for complete diagnosis is found in Monroe's Diagnostic Tests in Arithmetic. These tests deal with integers, common fractions and decimals comprising a total series of twenty-one tests, each having from twelve to twenty-four examples. Such a series of diagnostic tests undoubtedly yields a measurement of all the significant abilities within the field.

In language and grammar the Brigg's English Form Test and Charters' Diagnostic Tests in Language and Grammar for Pronouns

and Verbs<sup>1</sup> may be mentioned. The Charters' tests measure two abilities: (1) the ability to use correct forms of pronouns and verbs and (2) the ability to give the grammatical rule for the correct form. By a special arrangement for tabulation the record of each pupil is given so that the teacher can determine those errors which should receive more emphasis and those pupils who are lacking in ability. As teaching instruments, tests which point out to both teacher and pupil the strength and weaknesses of each individual in each phase of the subject measured are far more valuable than those which fail to reveal such situations.

The Freeman Scale for Handwriting and the Gray Score Card for the Measurement of Handwriting illustrate scales having complete diagnostic function. These tests measure separate abilities such as uniformity of slant, uniformity of alignment, letter formation, quality of line and spacing. Three degrees of each characteristic are included and the scores show the relative degree of perfection attained in each of the separate abilities.

**III. Partial diagnosis.** "Partial diagnosis" is used to indicate tests which do not yield such detailed information concerning pupils as those listed under complete diagnosis, but which are more analytical than those described under general diagnosis. There are, of course, no sharply defined lines of demarcation between the three degrees of diagnosis, complete, partial and general. These terms, however, have been used to describe in a general way the diagnostic qualities of standardized tests.

**Typical tests for partial diagnosis.** Woody Arithmetic Scales and the Courtis Standard Research Tests, Series B, are typical tests for partial diagnosis. They are general in the field of each operation but are diagnostic to the extent that they give information for each of the fundamental operations; addition, subtraction, multiplication and division. The knowledge that a particular pupil is weak in addition does not necessarily tell the teacher in what particular phase he may be weak. Such tests simply indicate but do not diagnose the condition.

**IV. Analytical diagnosis.** Standardized tests can show only the status of achievement. They do not give information concerning the method of work nor the cause of low or high achievement. A low score is a symptom; the interpretation of the symptom is quite

<sup>1</sup>Charters' tests yield a complete diagnosis only when the pupil's performances on the exercises of the tests are considered separately.

another matter. In prescribing remedial instruction, the fact that the pupil's achievement is below standard does not give sufficient information. The particular reasons for his failure must be ascertained. For this purpose one may employ "analytical diagnosis" for which three procedures are recognized.

1. Observing the pupil as he works.
2. Having the pupil do exercises orally.
3. Studying a pupil's test paper<sup>2</sup> or other written work.

**1. Observation of normal work.** This is one of the most common methods and involves observing the behavior of the pupil being diagnosed and securing a hint which, when later interpreted, gives some clue to the cause of the trouble. Many teachers do this, but unfortunately few have a systematic plan of procedure. Dignifying such a method by the name of diagnosis emphasizes to teachers the importance of engaging in this work systematically and of making it a more prominent part of their teaching. A few examples in the different subjects illustrate the significance which may be attached to an otherwise ordinary procedure.

a. **Observing a pupil engaged in silent reading.** If a teacher watches a pupil who is having difficulty with reading she observes that the eyes do not have evenly spaced brief fixation per line but move forward, jump back again and act in a generally irregular fashion. The trained teacher recognizes irregular eye movements as symptoms of reading difficulty. It may be that the pupil's span of recognition is too narrow. This in turn may be because the reading material is too difficult and contains many new or unfamiliar words. Inability to recognize certain words or letters results from insufficient experience with them. Irregular eye movements are caused because the child is not sure of all he has seen and he therefore looks back many times to make sure of the words which are necessary for comprehending the material which he is attempting to read.

b. **Observing a pupil as he works examples in arithmetic.** A pupil may be very slow at figures. As he attempts to add, the observing teacher notices that he is repeating each number such as 7 and 6 are 13 and 5 are 18 and 4 are 22 instead of simply calling the partial sums. Or, he may be adding each number by whispering to himself, counting on his fingers, or making little marks on his paper or at the blackboard.

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<sup>2</sup>Monroe, Walter S. Measuring the Results of Teaching. Boston: Houghton Mifflin Company, 1918, p. 138-52.

A trained teacher is skillful in noting certain symptoms which are significant, not in observing everything done by the pupil. This ability to discriminate between the various activities of the pupil and to select the essential things which have direct bearing upon his difficulty is an absolute necessity for the teacher who wishes to engage successfully in analytical diagnosis of this type.

**2. Oral tracing process.** When observation of the regular school work fails to disclose any illuminating facts regarding the incorrect mental processes of the pupils, the oral tracing method may be resorted to. The pupil is asked to tell the teacher just how he has done his work. In this way, particular errors and wasteful methods are frequently brought to light. Many times pupils show great resourcefulness and resort to methods which are far more difficult than the correct one. For example, a fifth grade pupil found the difference between some numbers by first dividing, then noting the remainder or lack of it, then multiplying and finally adding to or taking from the result as necessary. In subtracting 9 from 44 he proceeded as follows: 9 goes into 44 five times and 1 less; 4 times 9 are 36, minus 1 equals 35. It is evident that this boy knew certain multiplication combinations better than certain subtraction processes; he therefore used multiplication making such adjustments as were demanded by the problem.<sup>3</sup>

**3. Analysis of test results.** This method of diagnosis requires careful examination of the test papers as a means of locating the cause of pupil difficulties. Its use is limited because the nature of a pupil's errors cannot be determined always by scrutinizing his work. For example, if the correct sum is not obtained in the column addition tests of the Courtis Series B, the observer is unable to note the trouble as there is no record of the procedure. However, in common fractions and to a certain extent in subtraction, multiplication and division of integers the nature of the errors can be determined.

In arithmetic the errors noted on test papers may be tabulated so that the teacher can gain some idea of the kinds of errors made and also of the frequency of occurrence. If a fifth-grade class is found to have 56 percent of the errors in borrowing and 38 percent in the combinations, it is evident that there should be some concentrated drill on these troublesome phases of the work.

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<sup>3</sup>Uhl, W. L. "The use of standardized materials in arithmetic for diagnosing pupils' methods of work." Elementary School Journal, 18: 215-18, November, 1917.

An analysis of addition and subtraction of common fractions is made by examining the test papers and noting how the work is performed; that is, the number of pupils who add the numerators for a new numerator and the denominators for a new denominator; the number who multiply the numerators for a new numerator and the denominators for a new denominator; the number who fail to reduce the sum to the lowest terms and to a mixed number, etc. Frequently pupils employ certain methods which tend to waste their time and to introduce errors in the work. For example, in adding  $\frac{3}{14}$  and  $\frac{1}{14}$  some pupils fail to notice that the fractions already have a common denominator and reduce them to the common denominator, 196. In such a long and unnecessary procedure they are likely to make errors, thus obtaining an incorrect answer.

Spelling is another subject which produces an objective performance which may be studied at length. Misspelling often results from slovenly pronunciation by the teachers and pupils, from certain phonic irregularities of our language, from a lack of knowledge of the meaning of the word, from the length of the word or the position of the letters. The teacher, by examining the paper more closely than merely noting the number of misspelled words, will be able to locate points of needed emphasis. The inversion of certain letters, the substitution of letters having similar sounds, and the substitution of letters similar in appearance are a few of the errors which may be mentioned. A tabulation of pupil errors is a convenient way of calling attention to existing conditions, but it does not determine the cause of the difficulty.

Handwriting lends itself for analytical diagnosis. One has something definite to study over and analyze for the purpose of determining the particular shortcomings of the pupil.

A pupil's performance on a silent reading test may be studied for the purpose of determining the errors<sup>4</sup> which he is accustomed to make. There may be the omission of whole ideas, confused ideas, introduction of extraneous ideas and the predominance of certain portions of the passage not specifically referred to in the question. These wrong responses may in turn be due to faulty methods of study or faulty technique on the part of students in utilizing the information they possess.

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<sup>4</sup>Thorndike, E. L. "Reading as reasoning: A study of mistakes in paragraph reading," Journal of Educational Psychology, 8:330, June, 1917. "The understanding of sentences: A study of errors in reading," The Elementary School Journal, 18:107, October, 1917.

**V. Differential diagnosis.** Analytical diagnosis sets forth the nature of the errors but does not reveal the cause. Differential diagnosis on the other hand seeks to ascertain the causes for the errors in terms of the pupil's mental capacities.

The more common forms of diagnosis have referred mainly to a comparison of individuals and classes with grade norms. If the class was conspicuously below the grade norm a general type of interpretation was made, such as; the class as a whole should have additional instruction, the pupils needed a different type of training, or perhaps the trait measured had not received sufficient emphasis. In the case of individual pupils a similar procedure was followed. Scores below the grade norm were interpreted to signify a weakness in the pupil's training, for some reason he had failed to respond in a satisfactory manner. This type of diagnosis is valuable but it fails to take into account the capacity of the pupil to learn.

Differential diagnosis, however, is concerned with the inherent mental processes of pupils and recognizes wide differences among children of the same chronological age and grade. A mental-age norm which takes into account the general intelligence of the pupils seems, therefore, a better basis for comparison than a grade norm. The use of such a norm makes it possible to compare the achievements of each pupil with the norms for his own mental age. This comparison may be made conveniently in terms of the achievement quotient or A.Q. The instructional needs of the pupil cannot be determined until we know his capacity to learn.

If the A.Q. is 100 or above, and there is no reason for a lack of confidence in the test, we conclude that the pupil's achievement is just up to or above the standard for his mental age. If the A.Q. is less than 100, as 80, it means that the pupil's achievement is only 80 percent of his norm. An A.Q. below 100 may be regarded as evidence that continued search for additional information must be made. For this purpose, the diagnostician employs both psychological and informal tests and also tries to secure a complete history of the individual.

**1. Psychological tests.** A general test of intelligence is used to determine the pupil's general capacity to do the work of the school. If such a test shows that the pupil possesses average intelligence and if he still fails to achieve in a satisfactory manner the examiner must look still further for possible causes.

**2. Informal tests.** Standardized tests frequently fail to provide sufficient information to insure an accurate diagnosis. Informal tests may be modifications of standardized tests, or they may be especially designed by the examiner in order to help determine the specific nature of a certain pupil's difficulty.

**3. Developmental history.** Many educational defects are not due to immediate causes but have their beginning in the past, far removed from the grade in which they become manifest. The discovery of the existence of these defects often necessitates obtaining both a personal and a school history of the individual, so that nothing in the child's past will be omitted which might suggest a diagnosis.

First, the home conditions should be examined to see how these affect the child and his school work. The nationality of the parents and the language spoken in the home are factors not to be discounted. The attitude of the parents toward the child is also important as many ills are directly traceable to too much repression, severity, lack of sympathy, understanding, and so forth, on the part of the parents. Such unhealthy attitudes are frequently reflected in the child, making him unable to react in a normal manner, and setting him apart as an individual whose behavior is not like the majority of his fellows.

Secondly, the general physical condition of the individual should be carefully examined and special attention be given to nutrition and to the physical defects of speech, hearing and vision. Mental characteristics also, temperament, and play activities often point the way for more intensive diagnosis. Such questions as the following are a great aid to the diagnostician: Is the child timid, aggressive, industrious, lazy, careful, careless, independent, dependent, cooperative, or individualistic?

In order to leave no stone unturned which may give enlightenment in regard to the educational defects of pupils, certain pedagogical data should be collected and examined. Information such as: number of years the pupil has been in school; grade or grades skipped; failure of promotion, and reason; attendance regular or irregular, and the causes of irregularity; attitude of the pupil toward the teacher and toward the school, etc. may not in itself seem important but when interpreted in connection with all other available data may furnish significant bits of evidence which the diagnostician can utilize.

The field of differential diagnosis, however, belongs to the specialist and not to the class-room teacher. The success of the diagnostician depends upon her knowledge of the causes of defects in the various abilities which the school attempts to develop. She must have training and experience in order to interpret behavior even though this seems too subtle for analysis. She must possess a technique which will enable her to present insignificant clues or hints in such form that they will be recognized by others. And she must have a knowledge of proper remedial instruction in order to prescribe for each case that she has diagnosed.

**Technique of diagnosis with tests.** 1. **Selection of instruments.** In selecting tests for individual diagnosis the phase of the subject one desires to measure must be given first consideration. For formal diagnosis in reading, Gray's Oral Reading Test could be administered for the mechanics of reading; Courtis Silent Reading Test for rate; Burgess Silent Reading Test for rate of accurate interpretation; and Thorndike-McCall Reading Scale for the Understanding of Sentences to attack more difficult problems. The Haggerty Reading Examination Sigma I is designed for children who have made only a beginning in silent reading.

In handwriting, Freeman's Chart for Diagnosing Faults in Handwriting is good for individual diagnosis but not for the survey of a whole school system. It is also an excellent device for class-room use and enables the children to make their own diagnosis by comparing their work with the chart.

An analysis of arithmetical abilities is made possible by a number of tests. The Monroe Diagnostic Tests in Arithmetic furnish the most important types of arithmetical material arranged for the various grades, and are of great value to those teachers who wish to determine specific difficulties encountered by their pupils. The Woody Arithmetic Scales enable the teacher to sample a pupil's ability in the four fundamental operations. The Cleveland Survey Tests in Arithmetic give a number of views of a pupil's achievement in the four fundamentals; they are diagnostic but need further investigation with informal tests in order to ascertain the errors made by the individual. In summarizing these three arithmetic tests, we may say that the Cleveland Survey Tests in Arithmetic show how rapidly pupils can work the four fundamentals, the Woody Arith-

metic Scales emphasize the difficulty of the examples which a pupil is able to do, and the Monroe Diagnostic Tests in Arithmetic point out or diagnose the specific weaknesses of pupils.

In the content subjects, there are several tests which may be used but in general they are not very satisfactory. More complete analysis of these subjects must be made before tests comparable with those in arithmetic, spelling, handwriting or silent reading can be constructed. Furthermore, it should be noted that most of the available tests are general rather than diagnostic in character.

**2. Administration.** In administering tests a high degree of uniformity must be maintained, or valid comparisons cannot be made between individuals or groups. The authors of most of our standardized educational tests recognize this necessity and give definite directions which must be followed by the examiner. If the tests are for the purpose of appraisal of a good school system a trained person should conduct or at least supervise the examination, if for the purpose of diagnosis of individual pupils the class-room teachers may initiate and carry out the testing program.

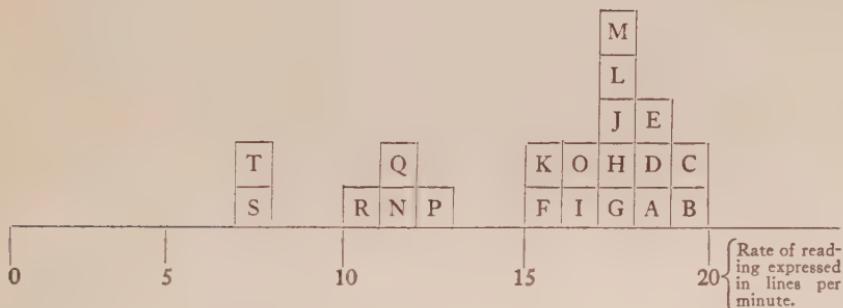
**3. Tabulating of scores for diagnosis.** **a. Tests yielding a single score.** When a test yields only one score for a pupil the results for the class may be assembled in a frequency distribution from which the class median or average may be calculated. Most standardized tests are accompanied by a class record sheet which facilitates this work. Such a tabulation of scores, however, is not very helpful in making a diagnosis of the class. For this purpose one may rank the pupils according to their scores as shown below. These scores were made by a third-grade class on the Burgess Picture Supplement Scale for Measuring Silent Reading Ability.

Pupil	Score	Pupil	Score	Pupil	Score
Helen.....	9	Marie.....	5	Annie.....	3
Thomas.....	8	Alice.....	5	Jack.....	3
John.....	8	Tom.....	5	Charles.....	2
Rose.....	6	Lillian.....	5	Leslie.....	2
Elizabeth.....	6	Mary.....	4	Edward.....	1
Fred.....	6	Evelyn.....	4	Anna.....	1
Robert.....	5	William.....	4		

A different and in some cases a more effective plan of arranging the scores made by each pupil is shown below.

$\left\{ \begin{array}{l} \text{Anna} \\ \text{Edward} \end{array} \right.$	$\left\{ \begin{array}{l} \text{Leslie} \\ \text{Charles} \end{array} \right.$	$\left\{ \begin{array}{l} \text{Jack} \\ \text{Annie} \end{array} \right.$	$\left\{ \begin{array}{l} \text{Mary} \\ \text{Evelyn} \\ \text{William} \end{array} \right.$	$\left\{ \begin{array}{l} \text{Tom} \\ \text{Alice} \\ \text{Marie} \\ \text{Robert} \\ \text{Lillian} \end{array} \right.$	$\left\{ \begin{array}{l} \text{Elizabeth} \\ \text{Rose} \\ \text{Fred} \end{array} \right.$	$\left\{ \dots \right\}$	$\left\{ \begin{array}{l} \text{John} \\ \text{Thomas} \end{array} \right.$	$\left\{ \begin{array}{l} \text{Helen} \end{array} \right.$
1	2	3	4	5	6	7	8	9

In order to emphasize the graphical feature in presenting single scores, some users of tests have represented each pupil by a block on which his name or initial is written. The following diagram is quoted from an article by Zirbes.<sup>5</sup>



Such an arrangement of scores enables the pupil to know his standing in comparison with other members of the class. If the test is repeated at regular intervals, he may observe his progress or lack of it, and be encouraged to compete with his own record.

**b. Tests yielding two scores.** When a test yields two scores each may be handled separately according to the plans just described. Usually, however, it will be helpful to combine the two scores in a single arrangement. The following diagram<sup>6</sup> represents the scores made by the pupils of a fifth-grade class on the addition test of the Courtis Standard Research Tests in Arithmetic. The plan of the diagram is very similar to the class record sheet which accompanies these tests. Each square represents the number of examples attempted and the percent of accuracy. Thus, when a

<sup>5</sup>Zirbes, Laura. "Diagnostic measurement as a basis for procedure." Elementary School Journal, 18:512, March 1918.

<sup>6</sup>Monroe, Walter S. Measuring the Results of Teaching. Boston: Houghton Mifflin Company, 1918, p. 120.

pupil's name is written in a square a graphical representation of two scores is shown. For example, Joe attempted eight examples and his percent of accuracy was between 80 and 89 percent.

Double lines, as in the accompanying diagram, may be drawn to represent the standards or norms. These four divisions simplify the interpretation of the diagram. The one in the upper right-hand position contains the names of all pupils who are above the standard in both scores; that in the lower left-hand corner, those pupils who are below standard in both scores; and the other two divisions, those pupils who are above standard in one score but below in the other. The diagram thus shows in a compact but expressive form the status of each member of the class as well as of the class as a whole. The general character of the instruction which the different pupils need is indicated. Those whose names appear in the upper left-hand division of the diagram should be given training to increase their rate of work. They are at present above standard in accuracy, and care must be exercised to prevent their work becoming less accurate as they increase their rate.

**Tabulation showing record of each pupil on each exercise of a test.** In the case of many tests it is helpful to know the record of each

Percent of Accuracy	Number of Examples Attempted										Number of Pupils
	2	3	4	5	6	7	8	9	10	11	
100											
90								John			1
80				Thomas Mary			Joe				3
70			Marie			Ann	Jack A.	Fred			4
60					Ruth		Bob		Morris Jack B.	Lillian	5
50							Ben	Eliz.			2
0- 49	Charles	Ray	May Cora	Virginia Mary Jack C. Tom Roy	Dick Edward Mildred Evelyn	Eva Betty		Horace			16
Number of Pupils	1	1	3	5	7	3	4	4	2	1	31

pupil on each separate exercise. A different form of tabulation for showing this information is illustrated below. A zero is placed in the appropriate column opposite the pupil's name to indicate that he has failed to do that exercise correctly. In the accompanying diagram, Pearl failed on exercises 1, 2, 5, 6, and 7. Such a plan of tabulation also shows the particular exercises which the class found difficult and which should receive general emphasis in the teaching.

Pupil	1	2	3	4	5	6	7
Pearl.....	0	0			0	0	0
Edwin.....					0	0	
Cecil.....					0		
Elizabeth.....							
Vera.....					0		0
Helen.....							
William.....						0	
Ben.....		0	0		0	0	
Gertrude.....					0		0
Roy.....	0	0			0	0	0
Helen W.....			0		0	0	0
Glenn.....					0	0	0
Herbert.....					0	0	0

**Diagnosis not a mechanical procedure.** Pupils present as great variations in their difficulties and needs for instruction as in their achievements. A mere mechanical arrangement for tabulating test scores or for representing them graphically will not lead to effective diagnosis. The plans described in the preceding pages should be useful, but the teacher should bear in mind that all pupils are not alike and that frequently information other than that recorded from standardized tests or even from analytical diagnosis must be sought in order to determine a pupil's instructional needs. A teacher, who wishes to become an efficient diagnostician, must do more than apply some mechanical procedure to the scores yielded by a standardized test.

## BIBLIOGRAPHY

### 1. Periodicals

- ASHBAUGH, E. J. "The measurement of language: what is measured and its significance," *Journal of Educational Research*, 4:32-39, June, 1921.
- CAPPS, A. G. "Function of tests and scales found in recent educational periodicals," *Journal of Educational Research*, 6:204-07, October, 1922.
- COURTIS, S. A. "Courtis tests in arithmetic: value to superintendents and teachers." Fifteenth Yearbook of the National Society for the Study of Education, Part 1. Bloomington, Illinois: Public School Publishing Company, 1916, p. 91-106.

- FREEMAN, F. N. "An analytical scale for measuring handwriting," Elementary School Journal, 15:432-41, April, 1915.
- JUDD, C. H., GATES, A. L., AND ZIRBES, LAURA. "Special review of Mrs. Burgess' Silent Reading Monograph," Journal of Educational Psychology, 12:348-54, September, 1921.
- KALLOM, ARTHUR W. "Analysis of and testing of common fractions," Journal of Educational Research, 1:177-92, March, 1920.
- KALLOM, ARTHUR W. "The importance of diagnosis in educational measurement," Journal of Educational Psychology, 10:1-12, January, 1919.
- MINNICK, J. H. "Certain abilities fundamental to the study of arithmetic," Journal of Educational Psychology, 9:83-90, February, 1918.
- MONROE, WALTER S. "An experimental and analytical study of Woody's Arithmetic Scales, Series B," School and Society, 6:412-20, October, 1917.
- MONROE, WALTER S. "A series of diagnostic tests in arithmetic," Elementary School Journal, 19:585-607, April, 1919.
- ROGERS, BERTHA, AND BAKER, TERESA. "Diagnosis and remedial activity in supervision," Journal of Educational Research, 5:21-26, January, 1922.
- THEISEN, W. W., AND FLEMMING, CECILE W. "The diagnostic value of the Woody Arithmetic Scales: a reply. Part I-II," Journal of Educational Psychology, 9:475-88, 567-80; November, December, 1918.
- WOODY, C. W. "Measuring some achievements in arithmetic," School and Society, 4:229-303, August, 1916.
- ZIRBES, LAURA. "Diagnostic measurement as a basis for procedure," Elementary School Journal, 18:505-22, March, 1918.

## 2. Books

- BRONNER, AUGUSTA. *The Psychology of Special Abilities and Disabilities*. Boston: Little, Brown and Company, 1917, p. 23-24.
- BURGESS, MAY AYRES. *Measurement of Silent Reading*. New York: Russell Sage Foundation, 1920. 163 p.
- FREEMAN, F. N. *The Teaching of Handwriting*. New York: Houghton Mifflin Company, 1914. 155 p.
- GRAY, W. S. *Remedial Cases in Reading: Their Diagnosis and Treatment*. Supplementary Educational Monograph No. 22. Chicago: University of Chicago Press, 1922. 208 p.
- GREGORY, C. A. *Fundamentals of Educational Measurements*. New York: D. Appleton and Company, 1922. 381 p.
- HINES, HARLAN C. *A Guide to Educational Measurement*. Boston: Houghton Mifflin Company, 1923. 270 p.
- HOLLINGSWORTH, LETA S., AND WINIFRED, C. AMELIA. "The psychology of special disability in spelling." Teachers College Contributions to Education, No. 88, New York: Teachers College, Columbia University, 1918. 105 p.
- JUDD, C. H. *Measuring the Work of the Public Schools*. Cleveland Survey, Philadelphia: Wm. F. Fell and Company, 1916, p. 98.
- MC CALL, WM. A. *How to Measure in Education*. New York: Macmillan Company, 1922. 416 p.
- MONROE, WALTER S. *An Introduction to the Theory of Educational Measurements*. Boston: Houghton Mifflin Company, 1923. 364 p.
- MONROE, WALTER S. *Measuring the Results of Teaching*. Boston: Houghton Mifflin Company, 1918. 297 p.
- PRESSEY, S. L. AND PRESSEY, L. C. *Introduction to the Use of Standardized Tests*. Yonkers, New York: World Book Company, 1922. 263 p.



